UNIT ⇒

# ACELLULAR LIFE

SYLLABUS ⇒

i, Classification of viruses.
ii, Discovery of viruses.
iii, Structure of viruses.
iv, Viral diseases (AIDS)

INTRO ⇒

⇒ Viruses are obligate parasites + intracellular parasites
* Special features: Particles of nucleic acids with protein coat (~ Envelope)
* They are never included in any kingdom.

STRUCTURE ⇒

⇒ All viruses are nucleocapsids (nucleic acid (DNA, RNA) capsid) biochemically.
⇒ They may have envelop.
⇒ Viruses are the only entities in which RNA can act as heredity material.

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## STATUS AND DISCOVERY OF VIRUSES ⇒

They are border line b/w living and non-living things.

### Living Features:

i, They can replicate or reproduce.
ii, They can infect their host.
iii, Mutation
iv, Can cause some diseases

### Non-living Features:

i, Acellular (no cytoplasm).
ii, can be crystallized.
iii, No metabolism
iv, Can't respiration
v, Can't excrete.

## DISCOVERY ⇒

* In 1800's some scientists like Louis Pasteur and Robert Koch beleived that diseases are caused by bacteria but some diseases are not caused by bacteria.

* In 1892 → Iwanosky → Porcelain filter (Bacteria can't pass)

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Porcelain filter —filtrate→ inject into organisms → diseases's symptoms

conclusion: There are ultramicroscopic agents which are smaller than bacteria and can pass through the porcelain filter and these are disease causing agents.

* In 1898 → bristles cattles (mouth) → pass through porcelain filter and these are filterable agents
(caused by)

* In 1900's → Microbiologists beleive that there are ultramicroscopic agents which cause diseases but they failed to isolate them.
for example:
Tobacco mosaic disease → in Tobacco plants.

* In 1935 → TMV is isolated by Stanely
  - Bacteria → Antibiotics ✓
  - Viruses → Antibiotics X

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## HISTORY ⇒

⇒ Edward Jenner: first time developed vaccine against viral diseases

⇒ Charles Chamberland: discovered filterable nature of rabies virus.

⇒ Ivanowski: discovered filterable nature of TMV

⇒ STANLEY: crystallization of TMV

⇒ Twort and D'Herelle: Discovery of bacteriophage.

## INTRO ⇒

PRIONS: If infection is caused by only proteins then infectious entities are known as prions.

VIROIDS:

If infection is caused by only RNA, then infectious entities are known as viroids

VIRIONS:

If infection is caused by nucleoprotein (protein + nucleic acid).

⇒ mature infectious viruses.

⇒ Capsid gives shape to the virus.

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* Viruses are obligate intracellular parasites. they are completely dependent on host and they can't be grown in artificial media and they replicate always inside the cell.

* They are acellular; can't be placed in any kingdom.

* Size Range: 20nm → 250nm (1000 times smaller than bacteria) 10 → 1000 times: 20nm (Parvoviruses), 250 (poxviruses) nm

* For reproduction, they just replicate.

* Resistant to antibiotics.

## STRUCTURE ⇒

### ESSENTIAL COMPONENTS

- Nucleocapsid.
- Nucleoprotein

Capsid
- forms protein coat
- capsid is made up of capsomeres (162 in herpes, 252 in adenovirus)
  - amino acids

Genome
- Develop core.
- Made up of DNA or RNA

### NON-ESSENTIAL COMPONENTS

- Envelope
  - Derived from host membrane
- lipoprotein in nature.

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## CLASSIFICATION ⇒

On the bases of Genome.

- DNA Viruses (HepesVirus)
  - Enveloped
    - Smallpox virus
    - (HBV)
  - Non-Enveloped
    - T-4
- RNA viruses
  - Enveloped
    - HIV
    - influenza viruses
    - Mumps and Measles viruses
    - Retroviruses
    - HCV
  - Non-Enveloped
    - HAV
    - Poliovirues

Rod shaped: TMV.

Spherical: poliovirus, flu, HIV

Tadpole: Bacteriophage.

i, All of the following are true about viruses except
(a) obligate intracellular parasites (b) Replicate by mitosis
(c) use metabolic machinery of host (d) resistant to antibiotics

ii, It is found in all the viruses.
(a) Envelope (b) Protein coat (c) DNA (d) RNA

iii, Lipid containing component of viruses is
(a) Envelope (b) Coat (c) core (d) capsid

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Virus:

Derived from the latin word 'venome' means poisonous fluid.

Virology:

Study of viruses, it's structure, mode of transmission, life cycle.

iv, It is not true for viruses.

(a) Host specific (b) Nucleoprotein particles (c) Its genome contain DNA and RNA (d) can replicate

v) Neurodegenerative disorders are associated with;

(a) Virions (b) Prions (c) Viroids (d) both a and c

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## STRUCTURE OF HIV ⇒

⇒ It is host specific

host (humans)

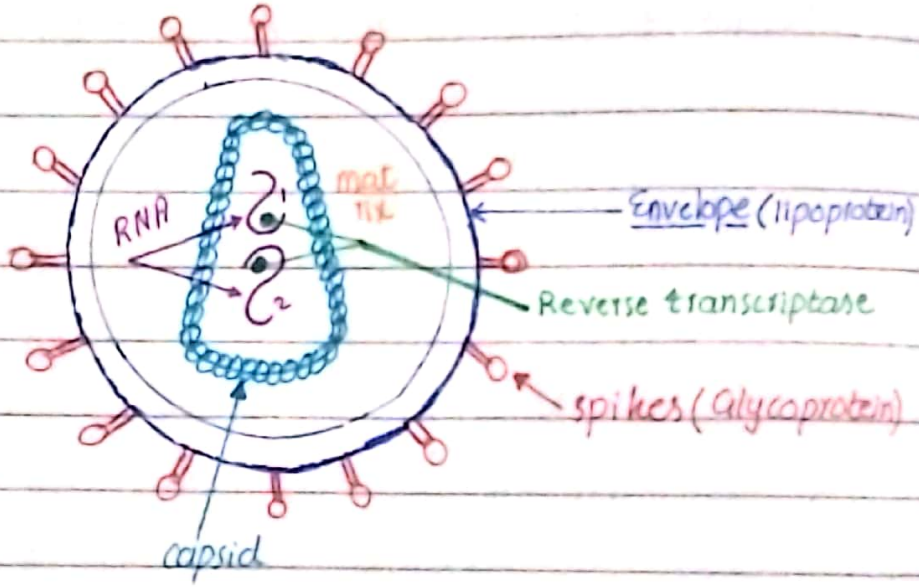
⇒ It attacks on the CD4+ cells

⇒ It attacks on those cells which have CD4-receptors. Like helper T. cells and some cells of CNS.

⇒ Spherical in shape.

⇒ It has some enzymes like Reverse trans kriptase, Integrase, Peptidase.

⇒ Shape of capsid of HIV is conical.




### Mode of Transmission:

i, by contaminated syringes

ii, by contaminated surgical instruments

iii, by blood transfusion.

iv, sexual contact

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CYCLE ⇒

i, Attachment : HIV attaches on cd4 receptor site

ii, Penetration : HIV penetrates in the plasma membrane of the host.

iii, Uncoating: In cytoplasm of the host cell, viral RNA and enzymes dispersed due to departure of protein coat.

iv, Reverse transcription: By the help of reverse transcriptase enzyme, viral DNA is synthesized by the viral RNA.

v, Integration: Viral DNA enters into the nucleus of the host cell by the help of integrase enzyme.

vi, Transcription: Viral RNA is synthesized by the viral DNA. & exits from nucleus.

vii, Translation: Viral protein is formed by the viral RNA.

viii, Assembly and incorporation: Protein coat is assembled and viral RNA and proteins and enzymes are incorporated into the protein coat.

ix, Budding and lysis: Now the virus is budded off from the plasma membrane of the host and the lysis of helper T-lymophytes is started and the person suffered from multiple infections and his lymph nodes are swollen.

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1, All of the following events of HSV life cycle occur in host cytoplasm except:
(a) Uncoating (b) Reverse transcription (c) Transcription (d) Translation.

11, RNA formed from proviral DNA is
(a) Single stranded (b) formed through transcription
(c) Proviral RNA (d) all of these

## VIRAL DISEASES ⇒

### HERPES SIMPLEX ⇒

★ Virus: Herpes viruses, DNA enveloped virus.
★ Source of transmission: oral secretions or physical contact with sores or by objects.
★ Symptoms: Blisters, vascular lesions in epithelial layers of ectodermal tissue. Most commonly in mouth, lips and skin sites.
★ Immunization: Antiviral drugs / avoid contact.

### MEASLES ⇒

★ Virus: RNA enveloped virus (Pyramyxovirus)
★ Source: Coughing and sneezing
★ Symptoms: fever, runny nose, cough, red eyes, red flat rashes on skin.
★ Immunization: Auto immunity, vaccination.

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## MUMPS ⇒

Virus: RNA enveloped virus (paramyxo virus)

Source: Coughing and sneezing.

Symptoms: Fever, muscle pain, headche, painful swelling of parotid glands

Immunization: Auto immunity, vaccination.

## POLIOMYELITIS ⇒

Virus: Polio virus/entero virus.

RNA non-enveloped virus, in spherical capsid.

smallest known virus.

Source: Oro-fecal route

Symptoms: Demage to motor neurons of spinal cord and leading to paralysis of limbs.

Immunization: Vaccination/ physiotherapy

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| Diseases | Viruses | Source | Symptoms | Immunization |
|---|---|---|---|---|
| Hepatitis A (infectious) | Picornavirus RNA. non envelop | oro. fecal route | Acuute infections vomiting, Nausea diarrhea, Jaundice | vaccination, Good hygiene |
| Hepatitis B (Serum) | DNA enveloped virus | blood, sexual contact, mother to newborn. | Vomiting, dark urine, yellowish skin, liver cancer | vaccination. Alpha interferon. screening blood |
| Hepatitis C (infusion) | RNA enveloped virus | blood | dark urine, abdominal pain, Yellow skin, cancer | no vaccination. Alpha interferon. screening blood |
| Hepatitis D | Viroid | blood or serum | Same → HBV | same → HBV |
| Hepatitis E | RNA non. enveloped virus | oro. fecal route | Acute infection Nausea, vomiting diarrhea, Jaundice | Good hygiene |
| AIDS | RNA enveloped virus | blood/sexual contact contaminated Syringes, Surgical instruments | weight loss, swollen lymphs nodes, fever | vaccination not available |

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# UNIT

# PROKARYOTES

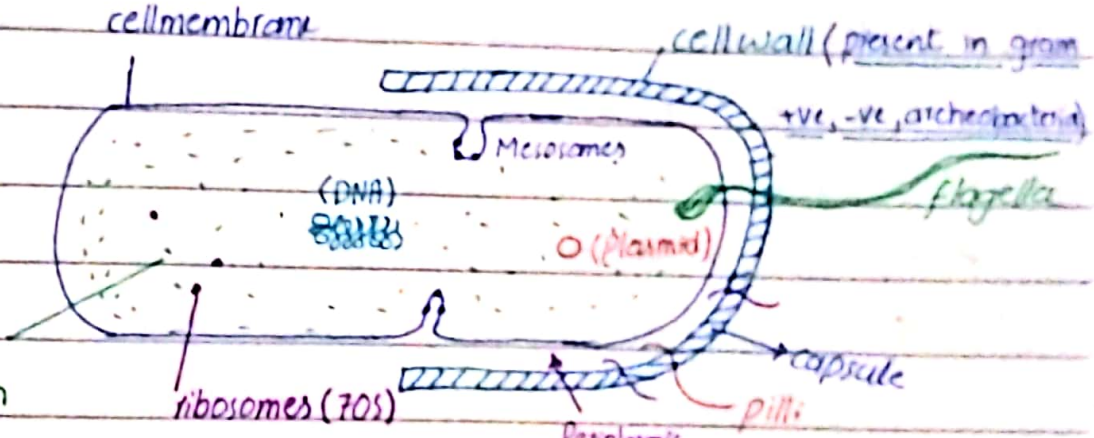
## SYLLABUS

i. Cellular structure of bacteria.

ii. Shape and size of bacteria.

iii. Importance and contia of bacteria.

## STRUCTURE ⇒




(Present in all bacteria)

(Present in Specific bacteria)

## RIBOSOMES ⇒

⇒ rRNA + Proteins

⇒ They are freely floating in cytoplasm.

⇒ 70S { 50S, 30S } ⇒ involve in protein synthesis

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## FLAGELLA ⇒

⇒ made up of flagillin protein.

⇒ components

- Basalbody: interact with cytoplasm and cell wall.
- Short curve: lie out side the bacteria.
- Helical filament: lie out side the bacterial cell.

⇒ helps in motality

**Classification:**

On the bases of flagella.

i, Atrichous: no flagella.

ii, Monotrichous: 1 flagella.

iii, Amphitrichous: tuft of flagella on both ends.

iv, Lophotrichous: cluster of flagella on one end.

v, Peri.trichous: A lot of flagella which cover whole body

## CELL WALL ⇒

⇒ It is protective multilayered structure above cell membrane.

⇒ functions: protection, definite shape, prevent from osmotic lysis.

⇒ Composition: Peptidoglycan

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Types:

| Gram +ve | Gram -ve |
|---|---|
| • retain blue-purple color | • don't retain color of dye |
| • with CV dye. | • Peptidoglycan → thin |
| • Peptidoglycan → thick | • Color washes out when |
| • Retain CV dye even | wash with alcohol |
| • after washing | • contain lipopoly saccharides |
| • 20-80nm thickness | • more resistant to antibiotics |
| • no outer membrane. | • 8-11 nm thickness, outer membrane ✓ |

## CELL MEMBRANE ⇒

- It is very delicate and elastic.
- Lacks sterols (cholesterol), its fluidity is very high
- It encloses cytosol

## PILLI ⇒

- Small, non-helical and hollow appendages.
- Composition: Pillin protein.
- function: Conjugation (exchange of genetic material through sex pilli)

## CYTOPLASM ⇒

- Semi-transparent, gelatinious str present under plasma membrane. ⇒ no membrane bounded organelle.
- Contains organic substances like proteins, carbohydrates, lipids and nucleic acids, inorganic: salts and water.
- more viscous than eukaryotic cytoplasm

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## CAPSULE ⇒

- Tightly bounde structure around cell wall.
- Composition → Protein, Polysaccharides
- Prevent from dehydration
- If it is loosely bound then it is called Glycocalyx (slime) ⇒ provide greater pathogenicity and protect from phygocytosis.

## RESPIRATION IN BACTERIA ⇒

i, Aerobic : require free oxygen
e.g ⇒ Pseudomonas

ii, Anaerobic : don't require free oxygen
e.g ⇒ Spirochete

iii, Facultative : bacteria can grow either in presence or absence of oxygen
e.g ⇒ E.coli

iv, Microaerophillic : bacteria require low conc. of oxygen for growth.
e.g ⇒ campylobacter

## MESOSOMES ⇒

cell membrane invegination forming a structure called mesosomes. forms : vesicles, tubular, lamellae
functions : DNA replication, cell division, export extracellular enzymes, involved in respiratory activity.

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## SIZE AND SHAPE OF BACTERIA ⇒

* length: 2 → 10 μm
* Diameter: 0.2 → 2 μm
* They appear in three different forms.

**Cocci** : ○ ⇒ spherical, non-motile

Diplococci: ○○ ⇒ in pair form

Streptococci: ○○○○○○ ⇒ in chain form

Tetrad : ⁘ , Sarcina: ⁘ (eight cocii)

Bacilli : ▭ rod shaped motile bacteria

Dipobacilli: ▭▭ in pair form

Streptobacilli: ▭▭▭▭▭ in chain form

Spirilla: They are corkscrew-shaped bacteria.
Spirilla never form clusters or colonies.

Vibrio: comma shaped

Spirillum: thick, rigid spiral.

Spirochete: thin, flexible spiral.

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## MODE OF NUTRITION ⇒

⇒ Two groups.

i, Autotraphs ii, Heterotraphs

### Autotrophic Bacteria:

⇒ Synthesize their food from simple carbon sources.

⇒ use in organic compounds like $CO_2$, and ions like carbonates, nitrates and sulphates.

⇒ Energy source for synthesis of food: sun

### Groups

i, Photoautotraphs:

⇒ possess bacteriachlorophyll, can manufacture their food

⇒ source of energy is sunlight.

⇒ Don't contain chloroplast, but non-stalked thalakoid membranes are dispersed in infolded region of cell membrane in cytoplasm.

⇒ The source of hydrogen is $H_2S$ not $H_2O$, they release S. instead of oxygen.

⇒ e.g: purple-sulphur bacteria, sulphur bacteria, non-sulphur bacteria

Chemoautotraphs

⇒ They don't use sunlight as a source of energy

⇒ They derive the energy by the oxidation of inorganic substance such as $H_2S$, $NH_3$, nitrates, nitrites and iron compounds

⇒ The process of food synthesis is chemosynthesis

## Heterotrophic Bacteria:

There are three types of heterotrophic bacteria.

### i, Saprophytic bacteria:

commonly known as saprobes

⇒ feed on dead organic matter

⇒ They possess powerful exocellular enzymes, they can break complex organic compounds.

⇒ they utilize energy that released in the process of breakdown of organic compounds.

⇒ The chemicals thus released become available to other organisms.

### ii, Parasitic Bacteria:

Don't possess the enzyme system for the breakdown of organic matter of their live host which include humans, plants, animals

⇒ Many parasitic bacteria cause diseases and are called pathogens.

### iii, Symbiotic Bacteria:

Symbiosis means: living together.

if relationship is beneficial to both partners → mutualism

if relationship is beneficial to one partner and other is neither benefit nor harmed → commensalism

⇒ Rhizobium radiciola: develops symbiotic association with roots of leguminous plants.

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## GROWTH IN BACTERIA ⇒

Increase in no. of bacteria.

**Factors:**

Temperature

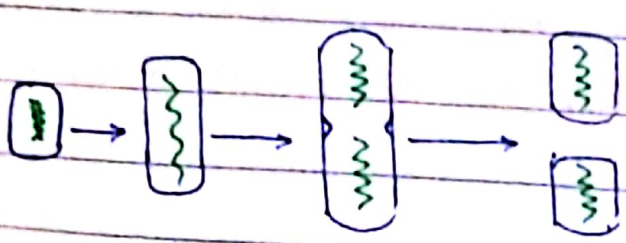
Nutrients

pH etc.

**Generation time:**

Time b/w two divisions.

e.g ⇒ in E. coli → 20 min.



if condition → favourable for E. coli → it can cover the whole surface of earth in 36 hours.

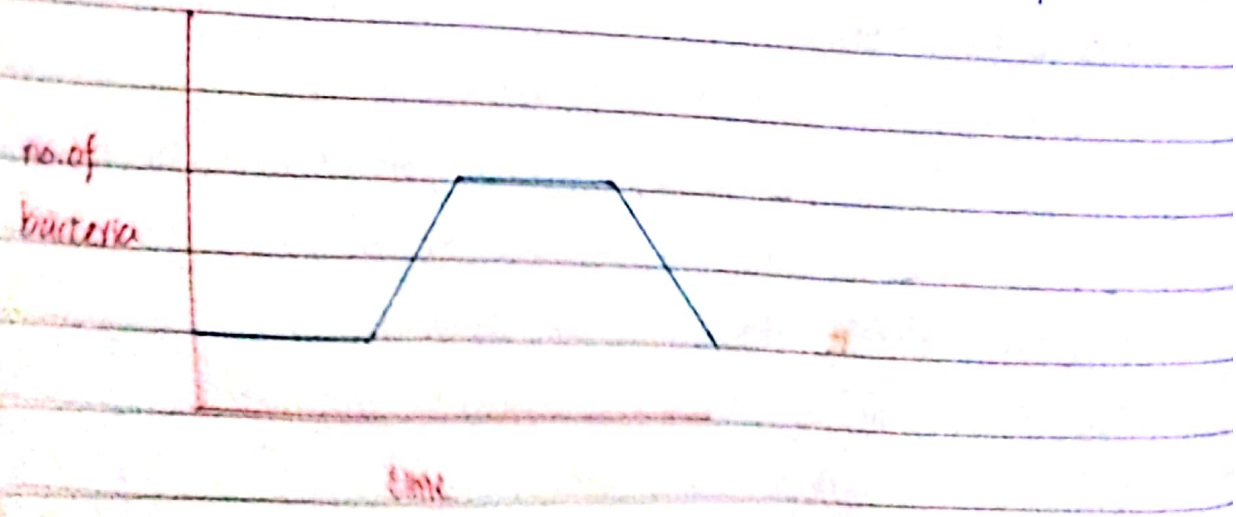
**Phases:**

i, lag phase (no growth)

ii, log phase (rapid growth) rate of reproduction > deathrate

iii, stationary phase (stop growth) reproduction rate = deathrate

iv, Decline phase (death phase) deathrate > reproduction rate

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## GENOMIC ORGANIZATION ⇒

⇒ Single (haploid) genome.

⇒ less amount of DNA as compared to eukaryotic DNA.

⇒ chromosomes → DNA
chromosomes → less proteins (linear)

**Nucleoid**: region in cytoplasm where DNA located.

**Plasmid**: some bacteria contain extra chromosomal DNA, which is double stranded (circular).

⇒ contains few genes (survival genes).

⇒ no role in metabolism

⇒ can replicate independently.

⇒ can be used as **vectors** in biotechnology.

⇒ resistant to antibiotics.

## IMPORTANCE ⇒

Read text book

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i, Rous sarcoma virus causes _____ in animals
(a) chicken pox (b) Measles (c) cancer (d) warts

ii, Warts are caused by
(a) Picomovirus (b) Papovirus (c) Adenoviruses (d) Reoviruses

iii, Orthomyxovirus are (a) +ssRNA (b) -ssRNA (c) ds DNA (d) ss DNA

iv, Pox virus is (a) +ssRNA (b) -ssRNA (c) ss DNA (d) ds DNA

v) Mildrash is caused by (a) Reovirus (b) Retrovirus (c) Parvovirus (d) orthomyxovirus

vi) which of the following serves as template for mRNA synthesis (a) ssRNA (b) +ssRNA (c) -ssRNA (d) ds DNA
messenger transfer

vii) which of the following serves as template for DNA synthesis (a) ssRNA (b) +ssRNA (c) -ssRNA (d) ds RNA

viii) Viruses having an outer envelope studded with glycoprotein spikes (a) TMV (b) Adenovirus (c) Influenza virus (d) HIV

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# UNIT

# DIVERSITY AMONG ANIMALS

**ANIMALIA ⇒**

Derived from Latin word anemia means 'to breathe'

⇒ Multicellular, Diploid, Eukaryotic, Ingestive heterotroughs, Development from two dissimilar haploid gametes.

Origin: Evolved from protists → Protozoans (choanoflagellates)

**Protist Ancestors**

- 29 phyla — Eumetazoa (symmetrical)
  - (Diploblastic) Radiata — radial Symmetry
    - Phylem: Cnideria
  - Bilateria (Triploblastic) — Bilateral Symmetry
    - Acoelomate
      - no bodycavity
      - Platyhelminthes without meso. Phyla (flatworm) dermal lining
    - Pseudo coelomate
      - body cavity
      - Nematoda (Aschelminthes)
    - Coelomate
      - True body cavity lined by mesoderm.
- Parazoa (Asymmetrical)
  - Phylem: Porifera 1

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## Coelomate

### Protostomes
- blastopore acts as mouth
- Spiral cleavage
- unequal
- predetermined fate

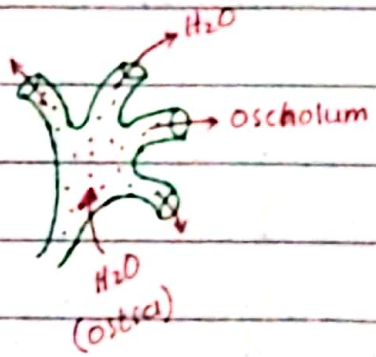
Annelids, Arthropods, Mollusca

### Deuterostomes
- blastopore acts as anus
- Radial cleavage
- equal
- indeterminate fate

Echinodermata, Haemichordates, Chordates

## PHYLUM PORIFERA ⇒

- Pore bearing animals
- Aquatic animals
- Life
  - larvae (motile)
  - Adult (sessile)
- No body organization




- Body layers
  - outer ⇒ Pinacoderm ⇒ Pinacocytes
  - noncellular gelly like scy ⇒ mesoglia
  - inner ⇒ choanoderm ⇒ choanocytes

- Cavity: Spongocoel
- Skeleton: Spicules exist b/w pinacoderm and choanoderm
- Life processes: Organ System: No, Reproduction: Asexual
  - (external) Budding
  - (internal) Gemmules

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Examples: Sycon, Spongilla, Hylonema, Cliona
majority sponges are marine

Importance:

- skeleton for washing and bathing.
- used in surgical instruments.
- sound absorber in buildings

## PHYLUM CNIDERIA ⇒

- Cnidocytes present which consist special structures "Nematocyst" known as stinging cells present on the surface of tenticles to use capture or paralyze the prey.
- Aquatic life
- Mode of life → freshwater
  → marine
- Size → microscopic to naked
- Diploblastic organization.
- Radial symmetry.
- Gastrovascular cavity.
- life processes: i, Diffused Nervous System, Sac like digestive System, no circulatory and Respiratory System.
- Reproduction: Sexual, Asexual

Polyp — non-motile
Medusae — motile and reproductive

- Alternation of generation

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Examples: Hydra, Obelia (Alternation of generation)
Aurelia (jelly fish), Actenia (sea anemones)
Medrepora (corals)

## PHYLUM PLATEHELMINTHES ⇒

- flat worms (Dorsoventrially flattened body)
- Size (from mm to several meters)
- Mostly endoparasites.
- Body organization → Bilateral
  → Triploblastic
  → Acoelomates
- Sac like digestive System.
- flame cells as excretory system.
- C.N.S
- Reproduction (Hermaphrodites: both sexes male and female)

Examples:
Dugesia (planaria)
liverfluke, Tapeworm (endoparasite in human)

- Adaptations for parasitic mode of life.
- Infestation and disinfestation.

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## PHYLUM NEMATODA

- Aschelminthes.
- Round worm (unsegmented)
- Size → micro → macro
- Bilateral Symmetry.
- Triploblastic and pseudocoelomates
- Tube like digestive System.
- Dorsal and Ventral nerve cords in Nervous System.
- Locomotion → Circular muscles
- Reproduction → Asexual, Sexual, Larva is present.
- Parasitic diseases:

  Ascaris lumbricoid

  Entrobius Vermicularis (Pinworm) (in large Intestine)

  (present in duodenum) Ancylostoma duodenale (Hook worm)

## PHYLUM ANNELIDA ⇒

- Segmented worms
- Habitat → Terrestrial
- Mode of life: metamerically segmented body.
- Digestive System: Gut Circulatory System: blood vessels.
  Nervous System: Nerve cords.
- Body organization: Triploblastic, bilateral symmetry, true coelomates.
- Hydrostatic Skeleton.

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Body Systems: Digestive → Distinct parts

Excretory → Nephridia

Nervous → C.N.S

Circulatory → closed

Respiratory → absent but respiration → Diffusion

locomotion → chitinous chiatae

Reproduction → sexual

larvae → Trochophore

## CLASSIFICATION

a) CLASS POLYCHAETA ⇒

- for locomotion: Parapodia
- prominent head, • aquatic
- Examples: Nerius chaetopterus, Trochophore larva

b) CLASS OLIGOCHAETA ⇒

- for locomotion: Setae
- No prominent head
- May be terrestrial/aquatic
- Example: cockroach • No larva formation

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c) CLASS HIRUDINAE ⇒

- fixed no.of segments
- No distinct head.
- Trochophore larva.

Importance:

Burrowing and churning activity of earth worm.

PHYLUM ARTHROPODA ⇒

- largest phylum.
- Similarities with annilids (segmented body, Appandages, cuticle)
- Habitat → everywhere
- Body structure: structurally variable, chitinous cuticle, Haemocoel.
- Body Systems: Digestive → Tube like
  Excretory → Malpighion tubule
  Nervous → Paired ganglia
  Respiratory → Tracheа
  Circulatory → Open
  locomotion → variable
  Reproduction → sexes separate

They do metamorphosis (incomplete)

- Economic importance: Harmful ⇒ Mosquito, tse-tse fly
  Beneficial ⇒ Honey bee and silkworm

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# CLASSIFICATION

## a) CLASS CRUSTACEA ⇒

- Aquatic , Gills for respiration
- Cephalothorax , Carapace exoskeleton
- examples: Cylops , Crabs, Daphnia , lobsters

## b) CLASS INSECTA ⇒

- Three distinct body parts.
- Metamorphosis
- Oviparous
- Examples: Dragon fly, mosquito, housefly
- largest class.

## c) CLASS ARACNIDA ⇒

- Spiders
- cephalothorax
- Respiration → gills, lungs, Book lungs
- Oviparous , no true metamorphosis
- Examples: Scorpians , Spiders, mites, ticks

## d) CLASS MYRIAPODA ⇒

- large no. of segments
- pair of legs on each segments
- Examples: Milipids and centipids

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## PHYLUM MOLLUSCA ⇒

- Second largest phylum.
  50k species
- Soft unsegmented body.
- Body organization ⇒ Triploblastic, Bilateral symmetry, coelomates, individually belongs to proterostomes
- Skeleton: exoskeleton
- Body Systems:
  Tube like digestive System, Paired Nephridia – Excretory, Open circulatory system, Muscular foot → locomotion
  Trochophore larva

Classification →
- Gastropoda
- Bivalvia
- Cephalopoda

- Importance →
  - Beneficial ⇒ involve in delegacy, road making process
  - Harmful ⇒ Shipworm

## PHYLUM ECHINODERMETA ⇒

- Spinny skinned animals, • Exclusively marine,
- Body organization ⇒ Bilateral symmetry, Coelomates, Deuterostomes
  but in starfish ⇒ radial symmetry.
- Body structure ⇒ variable, Biscuit like, Star shaped → long arm / short arm
  elongated, Central disc

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- Body Systems ⇒ well developed → Digestive, Reproductive
  Poorly Developed → Respiratory, Circulatory, Nervous System
- Water vascular System → for locomotion and food
- Regeneration.
- Similarities with chordates
  both have radial cleavage
  both are deuterostomes.
  blastopore → anus in both case

## PHYLUM HEMICHORDATA ⇒

- In b/w echinoderms and chordates
- soft worm like body and have three basic parts
  Anterior proboscis, collar and trunk
- unicellular epidermis,
- Digestive track → straight/variation
- Coelomic cavity/pouches
- Respiratory System → gills slits
- N.S → Subepidermal plexus
- examples Balanoglossus, Saccuglossus

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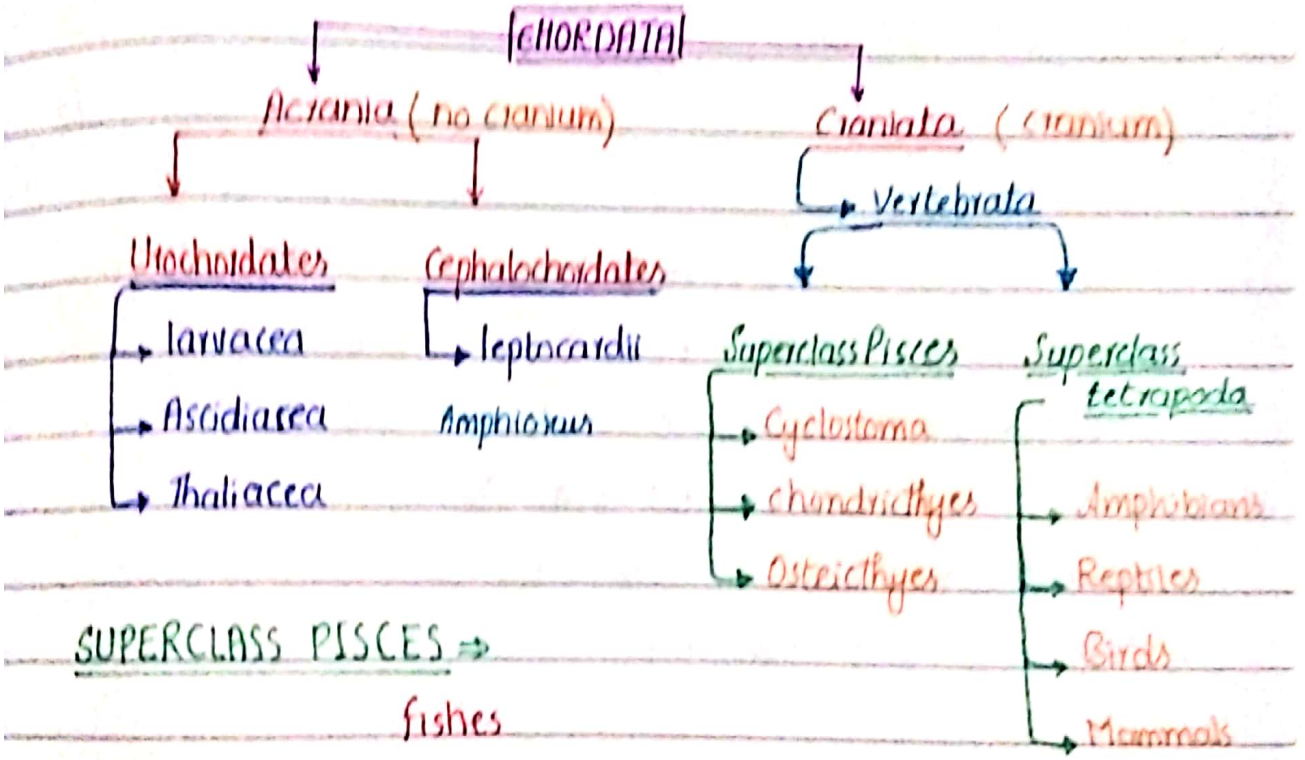
## PHYLUM CORDATA ⇒

- Notochord in all larval form
- C.N.S
- Paired gills opening at Embryonic stage.




## SUPERCLASS PISCES ⇒ fishes

### Class Cyclostoma

- Most primitive
- Jawless
- No scales
- Ventral suctorial mouth
- 6-14 gills pairs
- No stomach
- Hag fishes, lampreys

### Class Chondrichthyes

- Cartilagenous fishes
- Jaw
- placoid scales
- Ventral mouth
- 5-7 gills pair
- J-shaped stomach
- Shark, Skates, rays

### Osteichthyes

- Bony fishes
- Jaw
- Dermal scales
- Terminal mouth
- Gills supported by Arches
- Two chambered heart.

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## ADAPTATIONS TO AQUATIC LIFE ⇒

i, Strealine body ii, Swim bladder iii, Fins { Paired / Unpaired }

iv, Circulatory System v) Respiratory System

vi, Excretory System (kidney)

## SUPERCLASS TETRAPODA ⇒

### CLASS AMPHIBIANS ⇒

- Skin — smooth with many glands, no scales
- Mostly bony skeleton, • tailed or without tail.
- Limbs • Three chambered heart, • Separate sexes
- External fertilization, • Metamorphosis
- Anamniotes, • cold blooded
- Frog and toad (Examples)

### CLASS REPTILIA ⇒

- First true terrestrial vertebrates.
- Dry scaly skin, • four chambered heart (crocodile)
- Better developed limbs., • Internal fertilization
- Protective embryonic membranes, • cold blooded
- large yolk containing eggs

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## CLASS AVES ⇒

- Earliest known fossils Archeoptyrex
- Stream Lined spindle shaped body.
- Limbs for flying, perching, running.
- Presence of beak
- Syrinx as voice organ. , • four chambered heart
- Internal fertilization , • warm blooded.
- No urinary bladder in excretory system.

## CLASS MAMMALIA ⇒

- Evolved from Cotylosaurs, • very successful group of living organisms. , • Body covered with hairs.
- Muscular diaphragm, • External pinna, • Ear bones
- four chambered heart, • Enucleated RBC's

### Classification

| Prototheria | Metatheria | Eutheria |
| --- | --- | --- |
| egg laying | pouched mammles | Placental mammals |

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